PATHOLOGY RESEARCH

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Pathology research addresses the important diseases affecting sugarcane in Louisiana. The overall program goal is to provide farmers with practices to minimize losses to diseases in a cost-effective manner. Projects during 2021 included screening for resistance to multiple diseases; generating phenotypic data for developing and validating molecular markers for resistance to leaf scald, mosaic, brown rust, and smut; providing support for healthy seedcane programs to manage systemic diseases; and billet planting. Research results on billet planting are reported separately.

Evaluating Disease Resistance in the Variety Selection Program

Resistance to smut was evaluated for experimental varieties in the variety selection program in an annual inoculated test at the Sugar Research Station, and a range of resistance was detected among the clones (Table 1). Infection levels were lower than average in the susceptible check varieties, so intervals for the different resistance ratings were adjusted. High susceptibility (ratings 7-9) was only detected in four experimental varieties: L 17-428 (7 rating), L 19-004 (7), L 19-015 (7), and L 19-023 (9).

The same selection population was inoculated and evaluated for resistance to leaf scald, and a range of resistance was detected (Table 2). The development of systemic symptoms following inoculation was adequate to allow rating of resistance responses in experimental varieties. Five received a rating at the higher end of the moderately susceptible range (ratings of 4-6): Ho 16-608 (6.3 rating), L 19-001 (6.3), L 19-013 (6.3). L 19-021 (6.7), and L 19-492 (6.3). One experimental variety received a rating in the low end of the highly susceptible range (ratings 7-9): L 18-441 (7.0).

Mosaic is spread from plant to plant by aphids. Therefore, monitoring natural spread by aphids has been included as an additional aspect of screening for resistance to mosaic in the variety selection program. Susceptibility to natural infection of mosaic due to aphid spread was monitored in the smut and leaf scald inoculated test. Each test row planted with experimental varieties had an adjacent row planted with mosaic infected cane to provide uniform exposure to an inoculum source. Eight varieties had at least one mosaic infected plant in one of three replicate plots. They included: HoCP 09-804 (2 plants), HoCP 14-885 (1 plant), Ho 16-608 (1 plant), HoCP 17-702 (1 plant), L 19-015 (1 plant), L 19-021 (1 plant), L 19-492 (2 plants), and L 19-497 (2 plants). Even with uniform exposure to inoculum, there is still a strong element of chance for infection by aphids. The results suggest some uncertain level of susceptibility to mosaic exists for the varieties exhibiting a low level of natural infection.

Table 1. Smut infection means and resistance ratings determined in an inoculated test for commercial check and experimental sugarcane varieties during 2021

Variety	Mean infection (%)	Rating[1]	Variety	Mean infection (%)	Rating[1]
CP 73-351	20	8	Ho 17-738	7	4
CP 89-846	6	4	L 18-438	9	5
HoCP 96-540	1	2	L 18-441	7	4
L 99-226	16	7	L 19-001	8	5
L 01-299	25	9	L 19-004	14	7
Ho 04-838	3	3	L 19-006	10	5
HoCP 07-613	0	1	L 19-007	3	3
HoCP 09-804	4	3	L 19-011	1	2
L 11-183	0	1	L 19-012	9	5
L 12-201	0	1	L 19-013	0	1
Ho 12-615	0	1	L 19-014	0	1
Ho 13-739	0	1	L 19-015	15	7
L 14-267	0	1	L 19-017	2	3
HoCP 14-885	0	1	L 19-020	0	1
L 15-306	0	1	L 19-021	1	2
HoL 15-508	1	2	L 19-023	35	9
Ho 16-600	0	1	L 19-483	0	1
Ho 16-608	0	1	L 19-486	5	4
L 17-410	1	2	L 19-487	3	3
L 17-428	16	7	L 19-492	0	1
HoCP 17-701	0	1	L 19-495	6	4
HoCP 17-702	0	1	L 19-497	0	1
HoCP 17-710	0	1	L 19-498	1	2
Ho 17-724	1	2			

[1]Resistance ratings assigned on a 1-9 scale in which 1-3 = resistant, 4-6 = moderately susceptible, and 7-9 = highly susceptible.

Table 2. Leaf scald resistance ratings determined in an inoculated test for commercial check and experimental sugarcane varieties during 2021

Variety	Visual severity rating[1]	Variety	Visual severity rating[1]
CP 73-351	5.3	Ho 17-738	4.0
CP 89-846	7.0	L 18-438	5.3
HoCP 96-540	5.0	L 18-441	7.0
L 99-226	6.0	L 19-001	6.3
L 01-299	5.7	L 19-004	4.5
Ho 04-838	5.0	L 19-006	4.7
HoCP 07-613	3.7	L 19-007	4.7
HoCP 09-804	5.7	L 19-011	3.7
L 11-183	5.0	L 19-012	5.0
L 12-201	3.7	L 19-013	6.3
Ho 12-615	6.3	L 19-014	4.0
Ho 13-739	4.0	L 19-015	5.3
L 14-267	3.7	L 19-017	3.7
HoCP 14-885	3.7	L 19-020	4.3
L 15-306	3.7	L 19-021	6.7
HoL 15-508	4.0	L 19-023	5.7
Ho 16-600	4.3	L 19-483	4.0
Ho 16-608	6.3	L 19-486	3.3
L 17-410	4.0	L 19-487	4.7
L 17-428	4.0	L 19-492	6.3
HoCP 17-701	4.0	L 19-495	4.3
HoCP 17-702	5.0	L 19-497	4.0
HoCP 17-710	5.0	L 19-498	3.3
Ho 17-724	4.0		

[1]Resistance ratings assigned on a 1-9 scale in which 1-3 = resistant, 4-6 = moderately susceptible, and 7-9 = highly susceptible.

Phenotypic Data for Developing and Validating Molecular Markers for Disease Resistance

Results are being obtained for resistance reactions (phenotypes) of clone populations selected for association and validation of molecular markers for resistance to different diseases, including mosaic, leaf scald, brown rust, and smut, in studies being conducted in cooperation with Dr. Niranjan Baisakh. Clones with consistent mosaic inoculation results from the commercial and basic parent populations served as a diversity panel for an initial resistance marker association population. The marker association results are reported separately. The leaf scald inoculated test results are used for additional validation of the markers for leaf scald resistance that are now being used for marker assisted selection in the breeding program. Brown rust natural infection levels were insufficient to allow collection of additional, repeated resistance phenotyping of marker association populations. A diversity panel composed of 300 clones in the variety selection program increase stage were inoculated with smut and infection

levels and resistance ratings were determined during 2021. Resistance marker association analysis is in progress.

Healthy Seedcane Program Support

Disease testing was conducted by the Sugarcane Disease Detection Lab for the 26th year during 2021. Kleentek and SugarTech seedcane production was monitored for ratoon stunting disease (RSD), and no disease was detected. A total of 1,800 stalk samples from research farms, variety increase plots, and grower fields were tested for RSD with no positives detected. The Local Quarantine supplied healthy plant material of active experimental varieties from the 2017 series to the two seedcane companies to establish Foundation Stock plants that will provide apical meristems for tissue culture. Limited testing was conducted on commercial farms, and no RSD was detected in 23 sampled fields (Table 2). A total of 8,926 leaf samples were tested for Sugarcane yellow leaf virus as part of the LDAF Sugarcane Seed Certification Program (Table 3). Three fields exceeded the 10% detection limit and failed to certify due to virus infection.

Table 1. RSD testing summary for 2021

Source	Location	No. of fields	No. of varieties	No. of samples
Louisiana growers	State-wide	23	5	574
Variety Release Program	1° & 2° stations	-	5	100
Helena SugarTech®	Foundation stock	-	6	19
Kleentek®	Increase plots	-	-	429
Local Quarantine	LSUAC	-	23	67
Research	LSUAC	-	-	611
Total samples		-	-	1,800

Table 2. RSD field and stalk infection frequencies in commercial fields from different crop cycle years for all varieties combined during 2021

Crop Year	Total number of fields	Average field infection (%)	Total number of stalks	Average stalk infection (%)
Plant cane	0	0	0	0
First stubble	4	0	102	0
Second stubble	7	0	162	0
Older stubble	12	0	310	0
Unknown	0	0	0	0
Totals/Averages	23	0	574	0

Table 3. Sugarcane yellow leaf virus testing summary for 2021

Source	Location	No. of fields	No. of varieties	No. of samples
LDAF	Seed Certification	262	-	7494
Helena SugarTech®	Foundation stock	-	6	16
Kleentek®	Foundation stock	-	18	50
Kleentek®	Other than foundation	-	-	1130
Local Quarantine	LSUAC	-	23	67
Research	LSUAC	-	-	169
Totals		262	-	8,926

NEMATOLOGY RESEARCH

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Nematode research at LSU AgCenter addresses important management considerations for plant-parasitic nematodes affecting sugarcane in Louisiana. The goal of the program is to provide farmers with effective strategies to minimize nematode associated crop losses. Projects during 2021 included surveying the distribution of nematode species in commercial sugarcane fields in Louisiana and establishing variety specific damage thresholds for the lesion nematode, spiral nematode, and ring nematode.

Survey of Nematode Species in Louisiana

Soil samples were collected from 62 commercial sugarcane farms, representing six major sugarcane producing parishes in Louisiana (Ascension, Avoyelles, Iberville, Pointe Coupee, St. James, and West Baton Rouge). The samples were collected from fields with varying soil texture and crop stage. Nematodes were extracted from a 500 mL subsample of soil at the LSU AgCenter Nematode Advisory Service. Plant-parasitic nematode genera recovered from samples included stunt nematode (*Tylenchorhynchus*), lesion nematode (*Pratylenchus*), spiral nematode (*Helicotylenchus*), ring nematode (*Criconemoides*), and lance nematode (*Hoplolaimus*) (Table 1). Stunt, lesion, and ring nematodes were recovered frequently (>50% fields) and were often above the establish damage threshold for sugarcane varieties grown in other regions of the world.

Table 1. Recovery rate of plant-parasitic nematodes from soil samples collected from 62 commercial sugarcane fields from six major sugarcane producing parishes in Louisiana

Parish	Fields (#)	Stunt Nematode (%)	Lesion Nematode (%)	Spiral Nematode (%)	Ring Nematode (%)	Lance Nematode (%)
Ascension	6	50	50	50	67	0
Avoyelles	1	0	0	100	0	0
Iberville	22	55	41	41	55	14
Pointe Coupee	16	69	63	25	50	25
St. James	3	33	33	66	0	0
West Baton Rouge	14	71	57	7	79	0

Sugarcane planted in lighter soils (sandy loam and silty loam) supported higher population densities of stunt nematode, lesion nematode, and ring nematode, whereas heavier soils (clay) supported higher spiral nematode population densities (Table 2).

Table 2. Influence of soil texture on the abundance of specific plant-parasitic nematodes

Soil Texture	Fields (#)	Stunt Nematode (#/500 mL soil)	Lesion Nematode (#/500 mL soil)	Spiral Nematode (#/500 mL soil)	Ring Nematode (#/500 mL soil)
Clay	6	200	53	213	40
Silty Clay Loam	17	151	127	282	217
Silty Loam	35	265	217	133	214
Sandy Loam	4	400	100	20	260

Establishment of Variety Specific Damage Thresholds

A series of greenhouse experiments were performed to establish variety specific damage thresholds for lesion, spiral, and ring nematode. All three sugarcane varieties (HoCP 09-804, L01-299, and HoCP 14-885) showed similar susceptibility to lesion nematode, with soil population densities greater than 250 nematodes per 500 mL of soil causing a significant decrease in plant growth (Table 3). The spiral nematode inoculated at population densities ranging from 100 to 10,000 nematodes per 500 mL of soil caused no decrease in plant growth, suggesting that this nematode causes minimal damage to sugarcane despite its common occurrence. HoCP 14-885 showed greater sensitivity to ring nematode than HoCP 09-804 and L 01-299, with plant growth reduction observed at soil population densities as low as 250 nematodes per 500 mL of soil relative to that of 500 nematodes per 500 mL of soil for HoCP 09-804 and L 01-299.

Table 3. Damage threshold for lesion nematode, spiral nematode, and ring nematode on three commonly planted sugarcane varieties in Louisiana

Sugarcane Variety	Lesion Nematode (#/500 mL soil)	Spiral Nematode (#/500 mL soil)	Ring Nematode (#/500 mL soil)
HoCP 09-804	>250	No damage	>500
L 01-299	>250	No damage	>500
HoCP 14-885	>250	No damage	>250